H. H. MERCER.

PRESSURE FLUID ENGINE.

APPLICATION FILED AUG. 8, 1908.

974,413. Patented Nov. 1, 1910.

Fig. 1

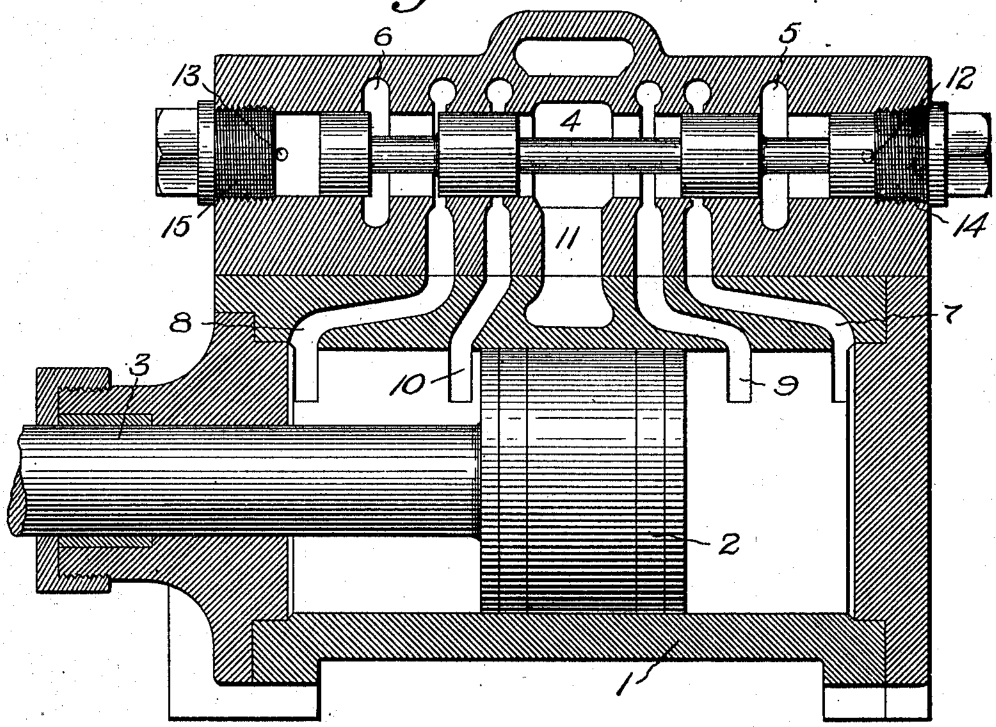


Fig. 2

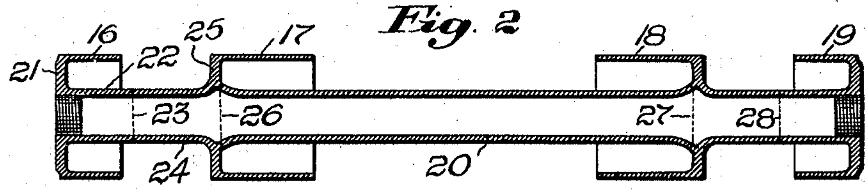
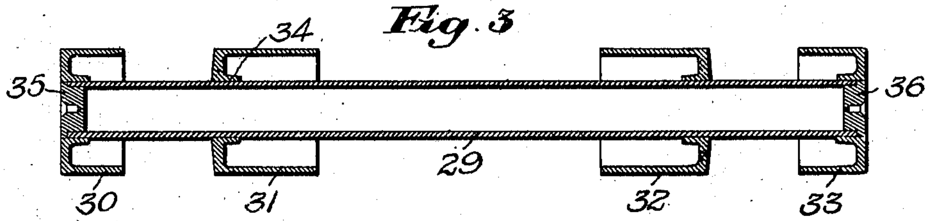


Fig. 3



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UNITED STATES PATENT OFFICE.

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PRESSURE-FLUID ENGINE.

974,413. Specification of Letters Patent. Patented Nov. 1, 1910.

Application filed August 8, 1908. Serial No. 447,560.

To all whom it may concern:

Be it known that I, Henry H. Mercer, a citizen of the United States, and residing at Claremont, in the county of Sullivan and State of New Hampshire, have invented an Improvement in Pressure-Fluid Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to valves and to engines employing valves and being more particularly, though not necessarily exclusively, concerned with valves intended for quick or instantaneous action through the actuating agency of pressure fluid. Pressure-actuated valves of this description are employed to a great extent in connection with direct acting engines, and particularly in the application of such engines to stone working and mining tools such, for example, as rock drills, stone channeling machines, coal punchers and the like. In these and other classes of apparatus where such pressure-actuated valves are employed, the valve is usually of the piston type, consisting of a stem with a number of spool or piston members of enlarged diameter secured thereto. Such a form of valve is often employed to control directly the admission of pressure fluid to the working cylinder and its exhaust therefrom, or sometimes the main pressure-actuated valve may itself be controlled and reversed by the pressure control of an auxiliary valve, the latter, in turn, reversed by pressure admitted by a third valve. In any case, however, pressure-actuated valves of this type are usually intended to be given a quick and sudden movement, under the admission of pressure to one end or the other of the valve chamber, this resulting in throwing the valve violently from one extreme position to the other. The shock or blow of the valve thus thrown may be absorbed by a pressure-fluid cushion at the end of the valve chamber, but, more often and usually, stops or buffers are provided at the ends of the chamber to receive this hammering action, which buffers are carried by plugs threaded into opposite ends of the valve chamber. The hammering action of these pressure-actuated valves against their buffers is the cause of frequent breakage in the valves themselves, while the weight of such valves and the momentum resulting from their rapid movement and frequent blows, often causes the stripping of the threads on the buffers or the threads of the casing into which the buffers are screwed.

It has heretofore been attempted to reduce the weight of the valve and thereby diminish the force of its blow by hollowing out the spools, but, inasmuch as the only practical way heretofore of forming the valve and the spools has been by turning the stem out of a solid bar of metal, leaving the spools integral therewith, this has left a cup-shaped spool on the stem with the grain of the metal in the disk-shaped bottom of the cup running lengthwise the axis of the valve or transverse the thin, shell-like bottom of the cup. With the grain of the metal thus placed, it is capable of withstanding only slight strain lengthwise the valve, and, when the valve strikes its buffer at the end of its throw, the momentum of the spool is apt to shear it off close to the stem, if enough metal has been removed to materially reduce the weight.

One object of my invention is to provide a valve having a minimum amount of metal, and, therefore, of a minimum weight, while, at the same time, so constructing it that it will be capable of withstanding all working strain.

My invention will be best understood by reference to the following description when taken in connection with the illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings: Figure 1 is a longitudinal section, through the cylinder and main controlling pressure-actuated valve, of a pressure fluid engine, the valve being of the type in which one form of my invention is embodied. Fig. 2 is a longitudinal section taken through the axis of the valve shown in Fig. 1; and Fig. 3 is a similar section showing a modified form of valve.

Referring to the drawings and to the embodiment of my invention there disclosed in Fig. 1, I have shown a pressure-fluid engine having the cylinder 1, piston 2 and piston rod 3,—the movements of the piston within the cylinder being controlled by a pressure-actuated controlling valve 4 slidably mounted in an adjacent valve chamber.

While the particular construction of the valve chamber and connected ports is not essential to my invention, in the illustrated embodiment thereof the pressure fluid is admitted to the valve chamber through ports 5 and 6 and thence alternately to the cylinder through the admission ports 7 and 8. The pressure exhausted from the cylinder passes alternately, under the control of the valve, to the ports 9 and 10 through the exhaust space 11.

The particular form of engine illustrated being employed in practice for operating a stone channeling machine wherein the cutting tools are directly connected to the piston rod 3, it is desirable at each end of the stroke to effect a quick reversal of the valve and this, in the present case, is accomplished by alternately admitting live pressure to, or exhausting the same from, opposite ends of the main valve chamber through the ports represented at 12 and 13, where the pressure, alternately acting upon the opposite heads or piston portions of the valve, throws the valve quickly to its opposite extreme position.

The means employed for controlling the pressure admission through the ports 12 and 13 is of no especial importance as related to the present invention, and the same is, accordingly, not illustrated, although in the engine which has been selected for illustration, this means consists of an auxiliary reversing valve (not shown) connected to be reciprocated by the piston head and of the general type shown in the patent to Ball No. 421,890, whereby, near the end of the downward or working piston stroke, the auxiliary valve is moved to admit pressure fluid through the port 13 to move the controlling valve 4 into the position shown in Fig. 1, thereby admitting pressure through the admission port 8 and reversing movement of the piston. At the end of the upward stroke the crosshead moves the auxiliary valve to admit pressure through the valve port 12 and exhaust the same through the port 13, reversing the valve and thereby reversing the movement of the piston. This, as well as the other constructional features of the engine form no essential part of my invention, which relates more particularly to the construction of the valve.

At the end of its stroke the movement of the controlling valve 4 is arrested by impact against one of the buffers 14 or 15 threaded into opposite ends of the valve chamber. In the present instance the valve is so constructed as to reduce its weight to a minimum, thereby not only reducing the impact against the buffers, and the likelihood of injury thereto, but reducing the likelihood of breakage in the valve itself, and, through its reduced weight, rendering it quickly acting and more suddenly responsive to the valve-actuating pressure.

Referring to Fig. 2 I have there shown one construction whereby these results are accomplished. The valve there shown is composed of a plurality (and herein four) separately formed, cup-shaped spool portions 16, 17, 18 and 19, which, together with the stem portion 20, are united into a composite structure forming the valve. Each spool portion comprises outer peripheral walls united, as shown, to an inner smaller tubular portion by means of an annular web, the latter forming the bottom of the cup and the entire piece being pressed, by means of a suitable die or dies, out of sheet metal, preferably sheet steel. For example, the spool portion 16 is constructed by forming a cup-shaped blank having the annular web 21 and the inner tubular part 22, the latter forming an axial extension of the bottom of the cup and extending in the same direction as the outer peripheral walls. The inner tubular portion 22 provides means for attaching the spool portion to the stem portion of the valve, the particular tubular portion 22 in the construction shown in Fig. 2 being united at the point 23 to a corresponding, but oppositely extending, tubular portion 24, which latter forms an extension of the web or bottom 25 for the spool portion 17.

The spool portion 17, in turn, is united directly at the point 26 to the stem portion 20, the latter comprising preferably a piece of hollow, seamless drawn steel tubing, with an outside diameter sufficient to give such stem portion the maximum stiffness and rigidity combined with the minimum weight. The opposite end of the valve which carries the spool portions 18 and 19 is similarly constructed. In the illustrated form it will be seen that the valve stem is formed of the stem portion 20 and the tubular portions 22 and 24, the latter comprising in effect extensions of the stem portion 20. Any suitable method of uniting these separately formed parts may be employed, but in the illustrated form of valve I preferably weld the parts together by any usual or suitable welding process which serves to metallically unite abutting ends of the several pieces along the lines indicated at 23, 26, 27 and 28.

Since each spool is pressed out of sheet metal together with its connecting web and its attached inner tubular member, the grain of the metal follows the shape of the completed blank, being best adapted at all points to resist the strains resulting from the hammering action of the valve. The grain of the web or cup bottom, instead of being lengthwise the axis of the valve, as would be the case were the valve turned down out of bar metal, is transverse the axis, and, not only may the spool be made of relatively thin material, but its strength throughout is brought to the maximum.

After the valve has been completed by

welding together the several component parts, as described, the spools may be finished or tooled down to the exact size required to fit the valve chamber, and the open ends of the valve stem may be closed as by the plugs shown.

While I have shown the valve as having four spools only, the particular number of spools is immaterial, and this system of valve construction may obviously be extended to a valve of any number of spools.

In the modification shown in Fig. 2 the valve stem itself is a composite structure of the stem portion 20 and the inner tubular extensions of the spool cups. This, however, is not necessary, and the valve stem may be made in the form of either a continuous solid spindle, or a continuous hollow stem, to which the stem portions can be secured in any suitable fashion, either by welding, brazing, or other method of metallic union, or there may be employed any other desired mode of fastening. In Fig. 3 I have shown such a modified construction employing the hollow valve stem 29 formed of hollow drawn steel tubing, upon which are assembled the separately formed cup-shaped spools 30, 31, 32 and 33, each spool, however, being preferably formed out of pressed sheet steel, in order to give the structure the minimum weight and the maximum strength. Each spool portion, as in the case of the first described construction, has an inner tubular extension struck up out of the bottom of the cup, but, instead of having such extension joined to the abutting end of a similar extension, or the abutting end of a stem portion, is formed so that it can be slid over the stem 29 and there secured at the desired position lengthwise the same. For example, the spool portion 31 is provided with the inner tubular extension 34 fitting over the stem 29 and secured thereto in some suitable manner, as by brazing. The spool portions 30, 32 and 33, are similarly secured to the outside of the stem, so that the structure when completed comprises the inner stem 29 with the several light, cup-shaped spool portions rigidly and metallically united thereto. The spool portions of the valve, when constructed as described, is machined down and the ends of the stem closed, as by the plugs 35 and 36.

The valve constructed as described is exceedingly light and delicate and quickly responsive to the admission of actuating pressure to the end of the valve chamber, so that it acts quickly to reverse the piston. On the other hand, its weight is such that it strikes the buffers a much lighter blow than a solid valve, while its structural strength effectively resists the resultant strains.

While I have shown and described two specific embodiments of my invention, it is to be understood that the same is not limited to the details of either embodiment or the construction and relative arrangement of parts, or to the application herein made of the invention, but that extensive deviations may be made from the described forms without departing from the spirit of the invention.

Having thus described my invention, what I claim is:

1. As a new article of manufacture, a valve for use in a fluid pressure engine, presenting a composite structure comprising a plurality of cup-shaped spool portions, each formed integrally out of sheet metal and having, in addition to the outer peripheral walls of the spool, a tubular part forming an axial extension of the bottom of the cup, whereby the grain of the metal of the cup bottom is transverse to the grain of the metal in the tubular part and the periphery, and one or more tubular metallic stem portions welded to said spool portions and forming with the tubular part thereof the stem of the valve.

2. As a new article of manufacture, a valve for use in a fluid pressure engine, comprising a composite structure consisting of a plurality of cup-shaped spool portions, each formed integrally out of sheet metal together with an attached tubular portion projecting from the bottom of the cup, and a connecting stem portion integrally joined to the said cup-shaped spool portion.

3. As a new article of manufacture, a valve for use in a fluid pressure engine, comprising a composite structure having a light cup-shaped metallic spool formed out of sheet metal and having integrally formed therewith an inner tubular portion struck up from the bottom of the cup and of lesser diameter than the outer periphery of the spool, whereby the grain of the metal in the cup bottom is transverse to the grain of the metal of the peripheral and inner tubular portions, and an adjacent stem portion to which the said cup portion is secured.

4. As a new article of manufacture, a valve for use in a fluid pressure engine, comprising a composite structure consisting of a hollow metal stem portion and a metallic cup-shaped spool portion having metallic union with said stem portion, said spool portion being formed out of sheet metal, whereby the grain of the metal in the cup bottom is transverse to the axis of the valve.

5. As a new article of manufacture, a valve for use in a fluid pressure engine comprising a stem member and one or more cup-shaped spools having metallic union with said stem member, said spools being formed of sheet metal to impart to said spools the maximum resistance to strains or shocks lengthwise the axis of the valve.

6. A pressure fluid engine having a pressure-actuated controlling valve therefor,

comprising a plurality of light cup-shaped spool portions and a hollow stem portion having metallic union with said spool portions, the latter being formed out of sheet metal to preserve the most effective position of the grain of the metal.

7. As a new article of manufacture, a valve for use in a fluid pressure engine presenting a composite structure, comprising a plurality of cup-shaped spool portions, each formed out of sheet metal and having, in addition to the outer peripheral walls thereof, a tubular part forming an axial extension of the bottom of the cup, the tubular extension of one spool portion having its end metallically united to the adjacent walls of the next successive spool portion.

8. As a new article of manufacture, a valve for use in a fluid pressure engine, comprising a composite structure having a stem portion and a plurality of light cup-shaped spool portions, each spool portion being formed out of sheet metal and having an inner tubular extension formed in the bottom or web of the cup, the inner tubular extension of each spool portion being metallically joined to the walls of the said stem.

9. As a new article of manufacture, a valve comprising a composite structure consisting of metallic stem portions having the grain of the metal lengthwise its axis and a plurality of light cup-shaped spool portions metallically joined thereto and having the grain of the metal transverse the axis of the valve.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

HENRY H. MERCER.

Witnesses:

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J. A. BRUCE.